



September 2, 2009

Mr. Blair Levin  
Executive Director  
Omnibus Broadband Initiative  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW, Room 6A-324  
Washington, D.C. 20554

***Written Ex Parte Notice:***

***In the Matter of a National Broadband Plan for Our Future, GN Docket No. 09-51.***

***In the Matter of the High-Cost Universal Service Support and Federal-State Joint Board on Universal Service, WC Docket 05-337, and CC Docket 96-45.***

***In the Matter of Developing a Unified Intercarrier Compensation Regime, CC Docket No. 01-92; and IP-Enabled Services, WC Docket 04-36.***

Dear Mr. Levin:

I apologize for not getting this fourth generation (4G) versus fiber-to-the-node (FTTN) versus fiber-to-the-home (FTTH) buildout cost comparison and performance analysis to you sooner. The amount of work, time and number of people needed to provide an accurate apples-to-apples 4G/FTTN/FTTH comparison and analysis for an actual high-cost rural area was much greater than I anticipated. As a follow-up to our *ex parte* meeting on Monday, August 17, 2009, I am providing a cost comparison (attached PowerPoint presentation, slide 7) and a performance analysis below of a 4G v. FTTN v. FTTH buildout for the rural exchange adjacent to the town of Gordon, Nebraska. This high-cost rural area has 503 subscribers and covers a geographic area of 1,370 square miles. Gordon, Nebraska, is currently served by Great Plains Communications.<sup>1</sup>

Many wireless companies claim that the rollout of 4G wireless service is a better alternative to wireline broadband platforms in high-cost rural areas. While there are advantages to a wireless network, there are also disadvantages. To provide the Commission with accurate, fact-based, and useful information on this subject, the analysis below and attached PowerPoint presentation investigates the three predominate broadband network strategies used in rural America at this

<sup>1</sup> This cost comparison and performance analysis has been prepared by NTCA and Great Plains Communications in consultation with Vantage Point Solutions.

time (FTTN, FTTH, and 4G) and contrast their benefits and drawbacks. In this analysis the ultimate selection of a network strategy should be based on the long-term costs, potential services, and viability of a platform, as well as what best fits a company's current network. In very rural markets, given the scarcity of customers and limited returns on investment, it is crucial that the longest-term strategy possible is undertaken since this is likely "once-in-a-lifetime" deployment. For this analysis, it is assumed that rural areas have existing wireline voice service and may have some wireless mobile voice service, but do not have broadband services either via wireline or wireless and thus is considered a "broadband greenfield" area.

### **Common traits:**

1. Fiber backhaul is common to all three scenarios – FTTH, FTTN and 4G wireless. Depending on the distance from the node to the switching office and the number of nodes in an exchange, this cost can be very high. However, fiber backhaul is a requirement in order to provide the amount of bandwidth necessary for the individual subscribers. Typical backhaul bandwidths to a node can vary from optical carrier-12 (OC-12) (approximately 622 Mbps) to OC-192 (approximately 10 Gbps).
2. The size of the serving areas may be similar depending of how much bandwidth is required to serve all subscribers. However, the bandwidth that can be attained at the edge of that serving area can vary greatly depending on the technology selected for the "last-mile" facilities.
3. With the exception of active FTTH designs, all other technologies are asymmetrical, meaning more bandwidth is available downstream (to the customer) than upstream (from the customer).

### **Advantages – FTTN (Fiber To The Node):**

1. FTTN pushes fiber closer to the subscriber, while utilizing the existing copper plant from the node to the subscriber. Retaining the existing copper plant results in a reduced cost for the deployment. FTTN is often an interim step for future FTTH deployment, since it is less expensive than FTTH. But it still serves as a solid foundation for the future upgrade to a FTTH network.
2. FTTN uses digital subscriber line (DSL or xDSL) technology for the broadband transport over the copper loops. xDSL provides asymmetrical transport, with the downstream bandwidth typically many times greater than the upstream bandwidth. This is a mature technology and customer premise equipment (CPE) is very inexpensive and available from numerous sources. This technology is also standards-based, again lowering the cost.

3. With FTTN, it is possible to attain download speeds of nearly 50 Mbps for subscribers located very close to the node. However, by using bonding technology (where multiple pairs are dedicated to each customer), better speeds are possible but customers at the edge will be limited to 5 Mbps or less.
4. Most FTTN deployments can be easily upgraded to FTTH with little additional work and at relatively small incremental cost. Many newer access platforms can serve both FTTN over xDSL and FTTH in the same chassis simply by using different plug-in cards.
5. Depending on the technology used and the distance from the node, FTTN can support telephone, data and video services.
6. When compared to a wireless network, most wireline networks, including FTTN, are more secure and less apt to suffer from outside influences that can reduce or interrupt the broadband signal.

**Disadvantages – FTTN:**

1. FTTN is bandwidth-limited, especially in the upstream. Even utilizing pair bonding, the maximum available bandwidth for any FTTN technology ((such as asymmetric digital subscriber line (ADSL) technologies, which include ADSL, ADSL2, ADSL2+, VDSL, VDSL2, or ADSL2+ with pair bonding)) is less than any of the current FTTH technologies.
2. FTTN is also distance-limited. Depending on gauge, FTTN is typically optimal to a distance of 12,000 feet. Beyond that distance, download speeds are at or below 5 Mbps.
3. Typical existing copper networks are older and more maintenance- intensive than a newer all-fiber network.
4. Copper networks are susceptible to external electrical influences, such as powerline influence. Powerline influence is becoming more of a factor on copper telecommunications facilities as distributed power (such as windmills) becomes more widespread.
5. FTTN requires many field electronic locations that require commercial power and batteries. These sites can be a reliability concern in areas where the commercial power is not reliable or is affected by weather, such as ice storms.

**Advantages - FTTH (Fiber To The Home):**

1. FTTH pushes fiber deeper into the exchange than FTTN, taking it all the way to the subscriber and providing the same high bandwidth speeds to all customers.
2. FTTH uses either active or passive technologies. Active systems have greater bandwidth than any currently available broadband platform, with 100 Mbps symmetrical systems commonly used and 1 Gbps symmetrical systems available. Future active systems will offer 10 Gbps symmetrical. Passive systems (PON or Passive Optical Networks) use a shared transport with splitters and result in lower upstream and downstream asymmetrical bandwidths to each subscriber. However, the most recent version of the PON systems known as GPON systems can still yield high bandwidths of 75 Mbps down and 40 Mbps up per customer in a 32-split scenario. Future enhancements to PON include 10G and wave division multiplexing (WDM), both resulting in more upstream and downstream bandwidth.
3. Fiber has limitless bandwidth, so FTTH is only limited by the electronics and the system design being deployed. Active upgrades should require only card changes at either end. Similar upgrades are anticipated for PON systems. However, the single mode fiber currently being used would not need to be upgraded. Hence, FTTH is considered a “future proof” network.
4. Unlike FTTN using xDSL technology, FTTH is not bandwidth-limited by distance; i.e., the subscribers at the end of the route are capable of getting the same bandwidth as those next to the node.
5. FTTH is a secure transport, with no outside influences (electrical or weather related) affecting the bandwidth.
6. The maintenance cost of FTTH installations is lower than FTTN installations because fiber is less susceptible to powerline influence or lightning damage. In addition, aging copper plant has more maintenance problems than newly constructed fiber.
7. It is relatively simple to upgrade most FTTN networks to FTTH. Most systems can have both networks in the same chassis. Typically, fiber is needed from the node to the home, and new electronics are needed at both locations.
8. Due to its large availability of bandwidth to every subscriber, FTTH is the best platform for providing all three services (telephone, data, and video).
9. FTTH fully supports high definition (HD) video services to every subscriber in a service area, regardless of the distance to the node.

**Disadvantages – FTTH:**

1. Initial cost is the biggest disadvantage to FTTH deployments. This is because FTTH involves constructing a new transport medium (fiber) to every subscriber.
2. Upgrading from one technology to another (GPON to 10 Gbps GPON or active to PON) may be expensive, especially if a particular vendor doesn't support an upgrade migration path.

**Advantages – 4G Wireless (fixed and mobile):**

1. Since 4G wireless uses wireless technology to reach the subscriber (last mile), costs for deploying a 4G system may be less than with FTTH in rural areas, depending on the circumstance. However, they are higher than a FTTN deployment.
2. 4G mobile has the obvious advantage of providing broadband to any subscriber within range of a tower, regardless of their location (at home or away, even in a vehicle). Even 4G fixed can provide this type of mobility through a wireless card for laptops.
3. 4G mobile obviously provides a voice service, as well as data. If enough spectrum is available for a 4G fixed system, voice is possible, although quality of service (QoS) must be implemented. Both mobile and fixed 4G systems can provide video, but it is limited, due to the higher bandwidth requirements.

**Disadvantages – 4G Wireless (fixed and mobile):**

1. Available bandwidth with 4G (fixed and mobile) is significantly less than with FTTH, and rather more comparable to FTTN. Claims are made that downloads of up to 60 Mbps can be attained, although an average throughput of 6 to 8 Mbps is expected. In very rural areas, the greater the distance a customer is from a tower, the less likely these average speeds will be attained. Like FTTH PON systems, 4G will be asymmetrical, with less bandwidth upstream.
2. Locating towers for wireless networks can be challenging and require access to private property. This cost is a relative unknown and will vary depending on the location. Larger towers will require guying and thus, more property, adding to the cost and possibly limiting the available locations.
3. 4G wireless (both fixed and mobile) is also distance-limited, with subscribers further from the tower getting less bandwidth than those closer in. This is also terrain-specific, with hills and mountains greatly reducing the distances in which service is available.

4. All 4G wireless services are subject to external influences (such as weather, foliage, structures, bodies of water, etc.). This can cause the service to degrade or even shut down completely.
5. While 4G wireless can be less costly than FTTH, it is generally more expensive than FTTN. There is not a migration path at this time from 4G to another platform. So going from a wireless network to a wireline network in the future would leave a large amount of stranded network.
6. At this time, only a fixed 4G platform is available. 4G mobile equipment will not be available until at least Q3 2010, and costs will likely be higher until more manufacturers make products available. The fixed 4G product does not currently provide facilities-based voice service, and data service is available only through a home received or a laptop device.
7. Since the 4G platform is using new technology, additional costs for core network equipment may be incurred, pushing the overall network build costs higher.
8. Although 4G wireless will support data and voice (mobile only at this time), it is not expected to be a good platform for video services due to limited bandwidth and external influences.
9. Maintenance on 4G wireless systems is expected to be higher than wireline services, predominately due to the effects of lightning on the equipment and the increased costs of labor associated with tower climbing.
10. Depending on the terrain, spectrum used, and other factors, 4G wireless will be limited to a 12-mile radius, probably less. With rugged terrain, increasing the service area or bandwidth will require additional tower sites and an increase in costs.

**Conclusion:**

FTTN is a good, reasonable and prudent interim strategy for broadband deployment, because it pushes fiber out to nodes (which can be used for future FTTH deployments), yet retains use of the existing copper infrastructure in the last mile, lowering the overall costs. But FTTN is distance-limited and the maintenance on the older copper plant will continue to increase. Also, bandwidth in both the downstream and upstream is “capped” due to the technology limitations associated with the copper last-mile plant.

4G wireless can be an appropriate alternative, especially if a network of towers and core network equipment already exists (as may be the case with existing cellular providers). If a 4G network has to be deployed from the ground up, it will be much more costly than FTTN as demonstrated in slide 7 in the attached PowerPoint presentation. It can also be used to “fill gaps” in an FTTN

or FTTH network, depending on the terrain. However, the spectrum is limited, so the bandwidth will not approach that available in FTTH networks. Additionally, it is limited by distance, like an FTTN network, and thus service quality and bandwidth decreases. Currently, only fixed 4G systems are available, meaning a facilities-based voice-capable mobile product is at least a year away (late 2010).

Of the three network technologies, FTTH is the clear winner performance-wise as demonstrated in slides 8 and 9 in the attached PowerPoint presentation. While the initial FTTH investment may be higher than 4G wireless in some circumstances, the fiber infrastructure offers almost limitless bandwidth. It is the best choice for "broadband greenfield" applications. And, if the existing carrier is a wireline provider, a cost-effective migration path exists from FTTN to FTTH. Finally, the overall operating costs for an FTTH network over a 20- or 30-year life span will be lower than either FTTN or 4G wireless.

Pursuant to Section 1.1206 of the Commission's rules, a copy of this letter and attached PowerPoint presentation is being filed via ECFS with your office. If you have any questions, please do not hesitate to contact me at (703) 351-2016 or at dmitchell@ntca.org. I look forward to discussing the National Broadband Plan universal service reform and intercarrier compensation reform with you again in the near future.

Sincerely,

/s/ Daniel Mitchell  
Daniel Mitchell  
Vice President  
Legal and Industry

DM:rhb  
Attachment

cc: Sharon Gillette, Julie Veach, Jennifer McKee, Marcus Maher, Don Stockdale, Al Lewis, Thomas Wyatt, Kris Montieth, Elise Kohn, Nicholas Alexander, Jennifer Schneider, Christi Shewman, Carol Simpson, Priya Aiyar, Bruce Gottlieb, Angela Giancarlo, Paul de Sa, Elizabeth Andrion, Zachary Katz, and Jonathan Baker





# FTTH vs. FTTN vs. 4G In Rural America A Cost vs. Performance Analysis

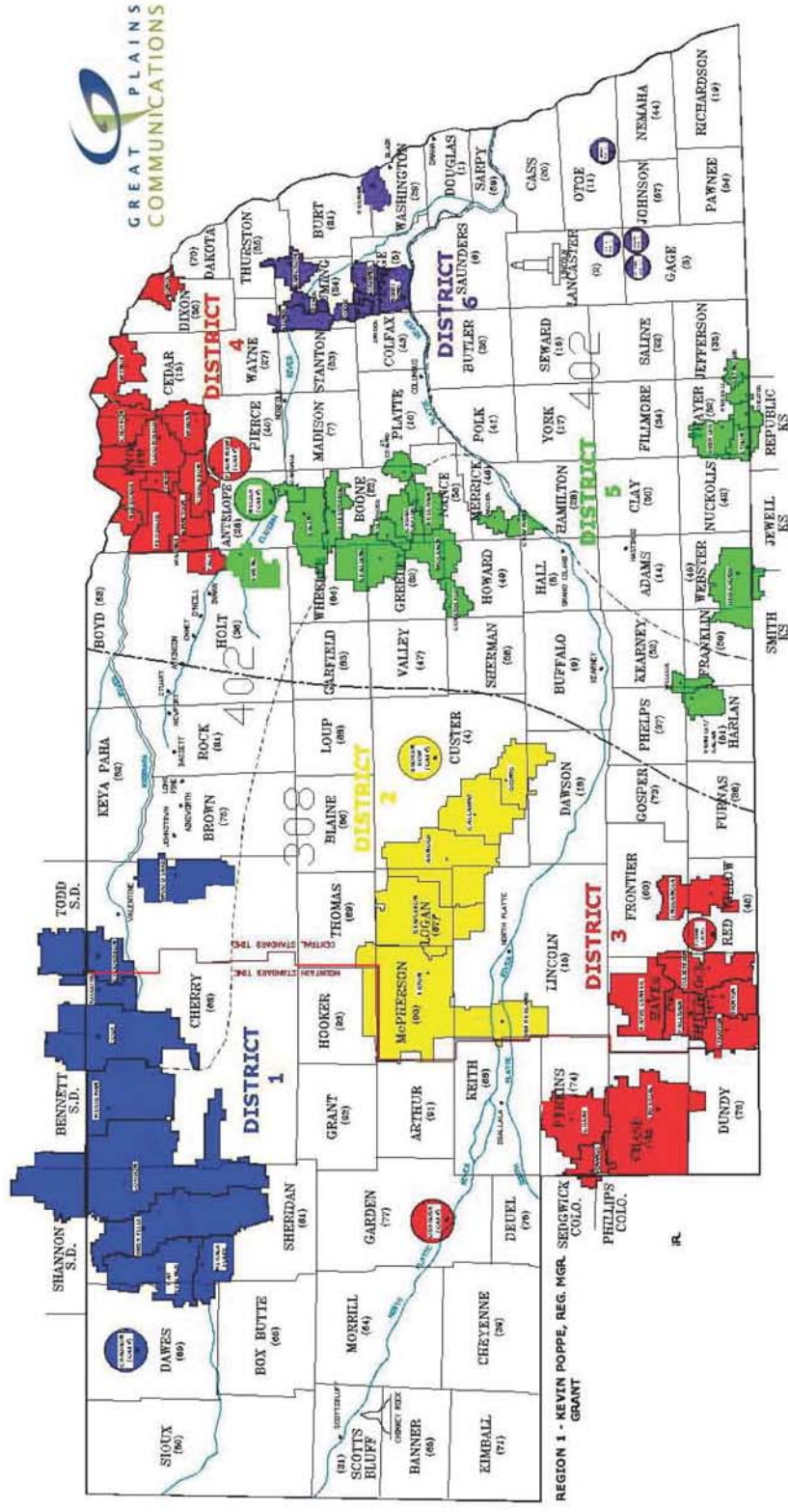
Providing Broadband to the High-Cost,  
Rural Portion of the Gordon, NE, Exchange  
Population 503  
Area Served 1,370 Square Miles  
September 2, 2009

Prepared by NTCA and Great Plains Communications  
in consultation with Vantage Point Solutions.





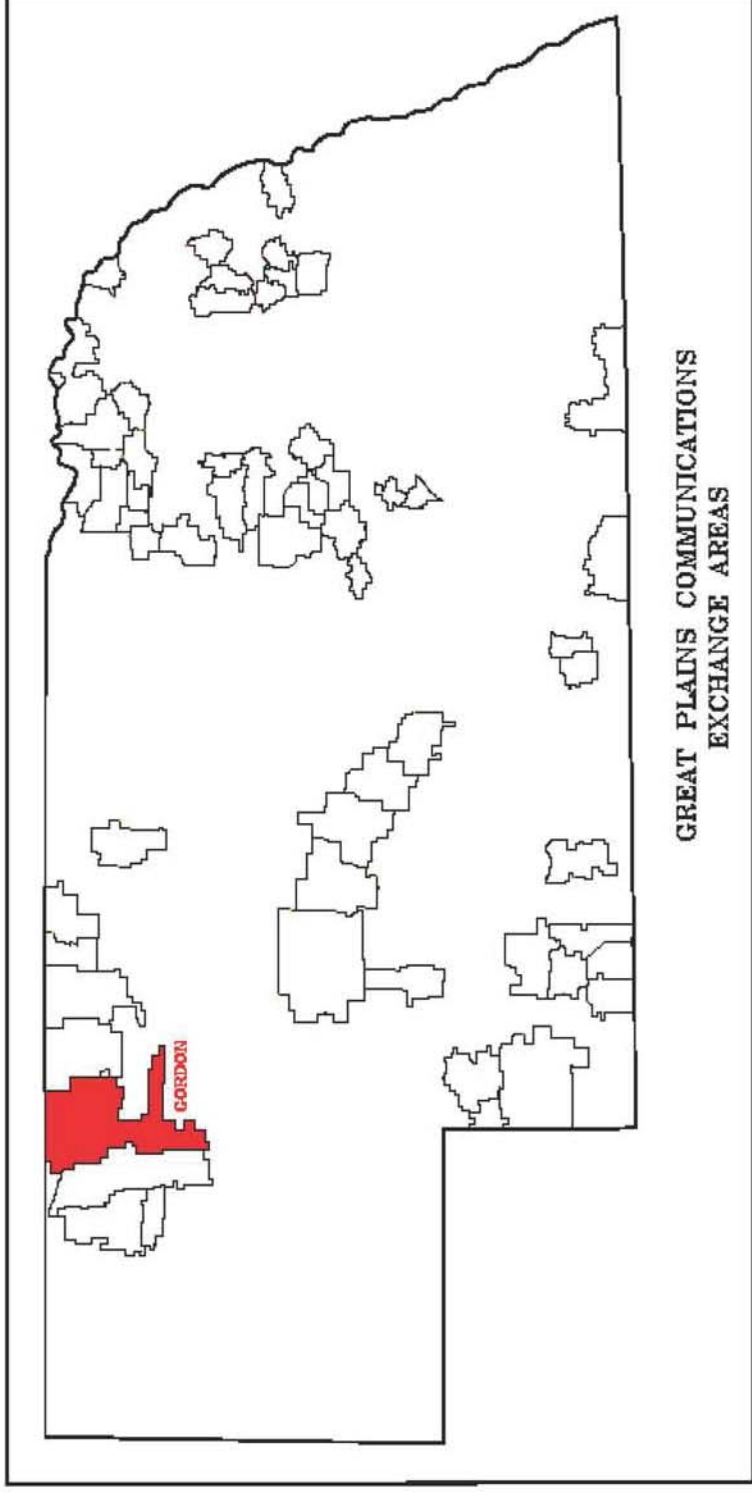
# Great Plains Communications Provides Service To Multiple Areas Across Nebraska.



GREAT PLAINS COMMUNICATIONS EXCHANGE AREAS



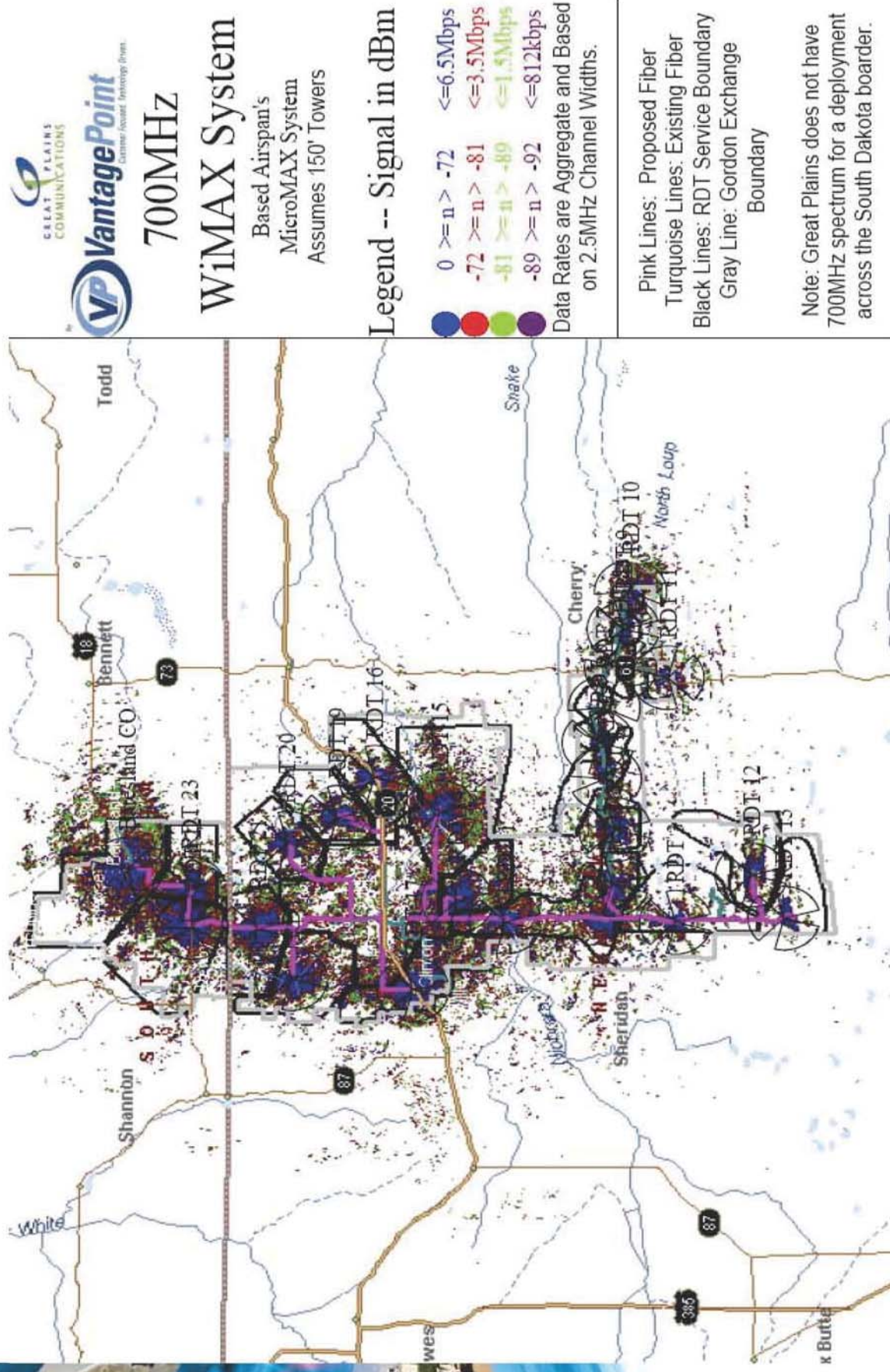
**Gordon, NE, exchange has 500 out-of-town subscribers across 1,370 square miles**







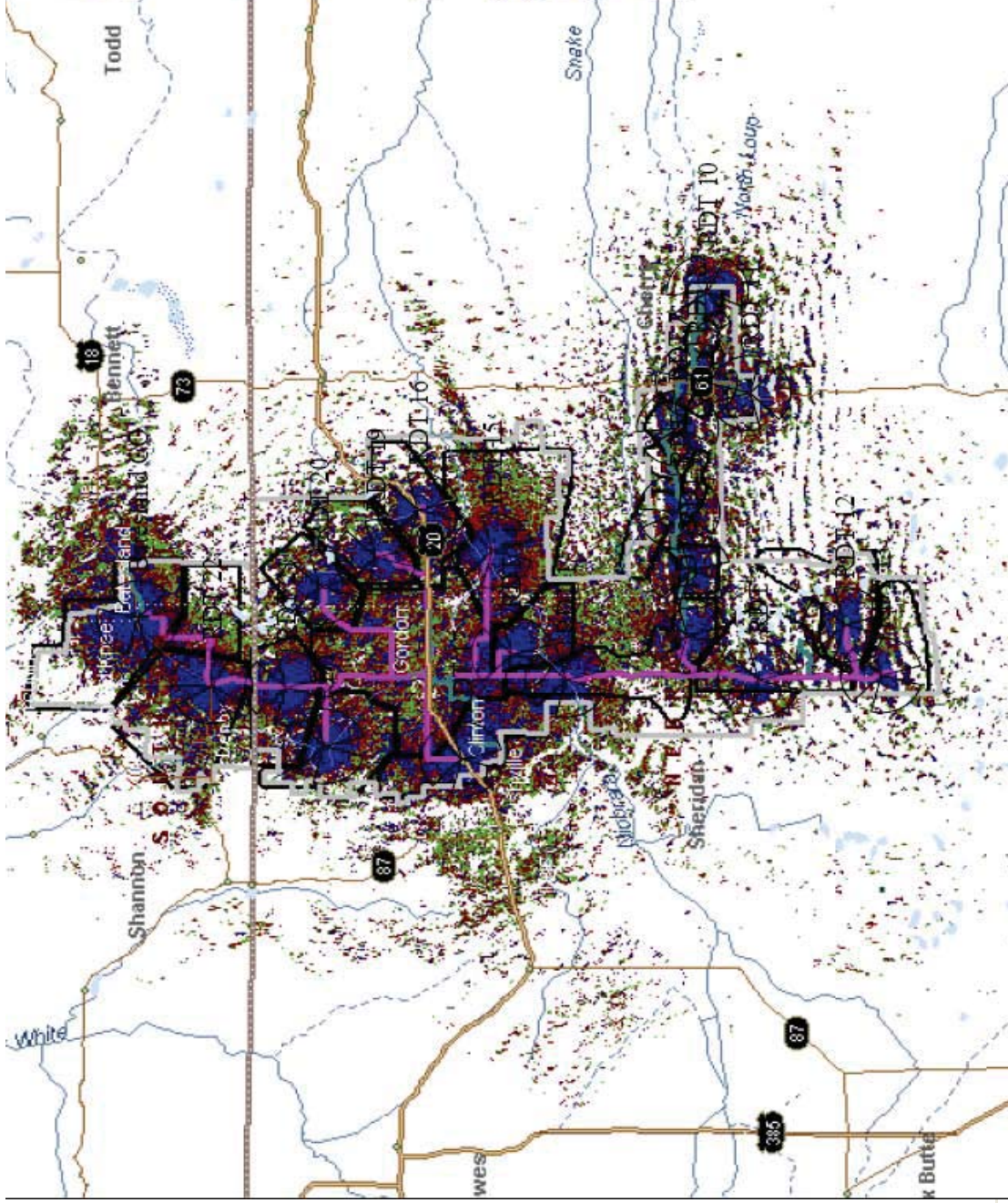
# Gordon 4G Layout with 24 - 150' Tower Layout







# Gordon 4G Layout with 21 - 300' Tower Layout



700MHz

## WiMAX System

Based Airspan's  
MicroMAX System  
Assumes 300' Towers

### Legend -- Signal in dBm



Data Rates are Aggregate and Based on 2.5MHz Channel Widths.

Pink Lines: Proposed Fiber  
Turquoise Lines: Existing Fiber  
Black Lines: RDT Service Boundary  
Gray Line: Gordon Exchange Boundary

Note: Great Plains does not have 700MHz spectrum for a deployment across the South Dakota boarder.



## Gordon Cost Comparison

	FTTH	FTTN	700 MHz WiMax <sup>1</sup>	700 MHz 4G/LTE <sup>2</sup>	700 MHz 4G/LTE <sup>2&amp;3</sup>
700 MHz Spectrum Cost	\$0	\$0	\$719,000	\$719,000	\$719,000
Core Network Electronics <sup>4</sup>	\$0	\$0	\$0	\$5,275,000	\$5,275,000
Electronics for Back Haul	\$15,000	\$15,000	\$40,000	\$45,000	\$45,000
Fiber Mileage (back-haul)	145	145	145	145	145
Fiber Cost/Mile	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
Total Fiber Cost (backhaul)	\$2,175,000	\$2,175,000	\$2,175,000	\$2,175,000	\$2,175,000
Fiber Mileage (node to sub)	\$637	\$0	\$0	\$0	\$0
Fiber Cost/Mile (node to sub)	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
Total Fiber Cost to Sub	\$9,555,000	\$0	\$0	\$0	\$0
Tower Cost (including land acq.)	\$0	\$0	\$118,400	\$123,400	\$207,333
Cabinet & Equipment Cost <sup>5</sup>	\$45,000	\$35,000	\$56,007	\$98,150	\$98,150
# Nodes	24	24	24	24	21
Total Cabinet Cost	\$1,080,000	\$840,000	\$1,344,168	\$2,355,600	\$2,061,150
Total Tower Cost	\$0	\$0	\$2,841,600	\$2,961,600	\$4,353,993
# Subscribers	503	503	503	503	503
CPE Cost per Sub <sup>6</sup>	\$400	\$50	\$579	\$600	\$600
Total CPE Cost	\$201,200	\$25,150	\$291,237	\$301,800	\$301,800
Total Cost for Network	<b>\$13,026,200</b>	<b>\$3,055,150</b>	<b>\$7,411,005</b>	<b>\$13,833,000</b>	<b>\$14,930,943</b>
Total Cost per Subscriber	<b>\$25,897</b>	<b>\$6,074</b>	<b>\$14,734</b>	<b>\$27,501</b>	<b>\$29,684</b>

### Notes:

- 1) Fixed wireless only (not voice capable)
- 2) Fixed and mobile wireless (voice capable in future)
- 3) Using 300' towers in lieu of 150' for better coverage; also eliminated three towers
- 4) Core network equipment only needed for a mobile-capable wireless product
- 5) Includes antennas and cabling
- 6) Fixed and laptop cards only; mobile sets should be available in 2011





# Fiber is the Answer for Speed

Speed and Economic Impact of Broadband Alternatives			
<i>Technology</i>	<i>Maximum Speed</i>	<i>Underlying Carrier Needed</i>	<i>Economics</i>
Satellite	Upload: 128 K Download: 3 Mbps	No	High Cost per Channel, High Customer Equipment Costs
CMRS-2G (Cellular)	Upload and Download: 144 K	Yes	
CMRS-3G	Upload: 256 K Download: 700 K	Yes	High Tower Density Required (unlikely in rural areas)
CMRS-4G/LTE	Upload: 1-3Mbps Download: Avg. 3-10 Mbps	Yes	High Tower Density Required
Fixed Wireless	Upload: 128 K Download: 6-8 Mbps	Yes	High Tower Density Required. Customer Locations May Also Require An Additional Pole For Antenna At Additional Cost.
Fiber	Upload and Download: 100-1000 Mbps	Yes	Most Easily Scalable for Additional Bandwidth

1. Wireless carriers *underestimate* their cost because they don't provide ubiquitous service and *overestimate* their speed.
2. Currently, wireless data networks are saturated. To increase speeds, more towers must be built. Wireless technologies depend on the wired network for transport.
3. The incremental investment in electronics over the economic life is substantially less for fiber than it is for wireless.



# Fiber is the Best Technical Answer

Performance of Broadband Alternatives			
Technology	Latency and Jitter	Weather Interference	Technical Limitations
Satellite	Severe, making real-time applications unusable	Service Unusable In Sever Weather	Line of Sight, Shared Bandwidth, Limits on Satellite and Channel Numbers
CMRS	Moderate	Service Slightly Impaired	Line of Sight, Shared Bandwidth between Voice and Data
Fixed Wireless	Moderate	Depending on Frequency Use The Service May Be Unusable or Impaired	Line of Sight, Shared Bandwidth, Poor Reliability, Short Range
Fiber	Negligible	Service Unaffected	Virtually None
			Security
			More Susceptible to Hackers, VPN functions poorly, if at all, emergency services not well defined
			More Susceptible to Hackers
			More Susceptible to Hackers
			Secured physically and by encryption

- Satellite cannot be used for VoIP, videoconferencing, gaming, Telehealth and applications using VPNs.
- Satellite and fixed wireless have rain/snow fade problems.
- Any “over the air” technology is not as secure as fiber.



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